IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

#8 p.21 6-21

APPELLANTS:	Gernot Hoyler	ATTORNEY DOCKET NO.: P98,0318
SERIAL NO.:	09/096,113	GROUP ART UNIT: 2763
FILING DATE:	June 11, 1998	EXAMINER: H. Jones
TITLE:	"COMPUTER-AIDED SIMULATION METHOD FOR DETERMINING THE ELECTROMAGNETIC FIELD OF A BODY"	

Assistant Commissioner for Patents
Washington D.C. 20231

APPELLANTS' APPEAL BRIEF

Dear Sir:

In accordance with the provisions of 37 C.F.R. § 1.192(a), Appellant herewith submits his main brief in support of the Appeal of the above-referenced application.

Real Party in Interest

The real party in interest is Siemens Aktiengesellschaft, assignee of the present application, a German corporation.

Related Appeals and Interferences

There are no related Appeals and no related Interferences.

Status of the Claims

Claims 1 -20 are on appeal and constitute all pending claims of the application.

Status of the Amendments

Amendment B is filed simultaneously herewith, making an Amendment in Claim 12 to respond to the rejection of Claim 12 under Section 112, second paragraph. No other amendments have been filed after the Final Rejection.

Summary of the Invention

The object of the invention is to determine the electromagnetic field of a body using a computer, so that electromagnetic compatibility of the body can be ensured before it is made, and thus to avoid optimizing cycles consisting of measurements and retrospective modifications. (P.2, lines 2 -6).

In general terms, the present invention is a computer-aided simulation method for determining the electromagnetic field of a body which has a plurality of subregions and contains a plurality of charges and currents. (P. 2, lines 7 -10). In each of the plurality of subregions, a global multipole expansion is made which represents the effect of the charges and currents for distant points in the form of a multipole expansion, and a local multipole expansion is made, which represents the effects of the charges and currents at points inside this one of the plurality of subregions in the form of a multipole expansion. (P. 2, lines 10 - 16). The electromagnetic field of the body is determined by superposition using the global multipole expansion and the local multipole expansion for the plurality of subregions. (P. 2, lines 16 -19).

The following steps for determining the electromagnetic field of the body are carried out iteratively until the error measure is of a predeterminable small size, $I = 0$ being taken as an initial condition:

a) Calculating the global multipole coefficients according to

$$C^g = GI$$

C^g being a vector made up of the global multipole coefficients of the plurality of subregions,

I being a vector which specifies a given current distribution,

G bing a matrix determining the global multipole coefficients in the relevant subregion of the plurality of subregions for the given current distribution I;

b) calculating the local multipole expansion with local multiple coefficients according to

$$C^1 = TC^g$$

C^1 being a vector made up of the local multipole coefficients of the plurality of the subregions,

T being a translation matrix through which the global multipoles are combined into local multipoles;

c) determining the electromagnetic field from

$$ZI = Z' I + Lc^1,$$

Z denoting an impedance matrix,

Z^1 denoting a part of the impedance matrix Z, representing couplings between the subregions,

L denoting a matrix for evaluating the local multipole coefficients. (P. 2, lines 22 -p.3, line 20).

In one embodiment, the subregions are of equal size. (P. 3, lines 21).

The size of the subregions are proportional to the distance from an observer region. (P. 3, lines 22- 23).

The relevant subregion of the plurality of subregions is in each case assigned to a zone with uniform physical attribute. (P. 3, lines 24 - 25).

In a refinement step, the subregion of the plurality of subregions is split into up to eight zones. (P. 3, lines 26 - 27).

An element which has an impedance and is a component of the subregion of the body is taken into account directly in the matrix Z′ as an impedance. (P. 3, lines 28 - 30)

The electromagnetic field is determined for predeterminable frequencies. (P. 4, lines 1 - 2).

The predeterminable frequencies are determined by a minimum frequency and by a maximum frequency, the method being started at the minimum frequency and the electromagnetic field being in each case determined, continuing as far as the maximum frequency, with a predeterminable stop size. (P. 4, lines 3 - 7).

The predeterminable frequencies are determined by a minimum frequency and by a maximum frequency, the method being started at a frequency between the minimum frequency and the maximum frequency, and the electromagnetic field being in each case determined, continuing as far as the maximum frequency or as far as the minimum frequency, with a predetermined step size. (P. 3, lines 13 - 18).

The electromagnetic compatibility of the body is determined. (P. 4, lines 22 - 23).

The present Specification includes numerous equations for supporting the above procedures. The Specification can be consulted for these specific equations, however, it would serve little purpose to repeat all or some of those equations herein. Moreover, it is not possible to "parse" those equations because later equations necessarily refer to or build on earlier equations and therefore presenting one or two equations herein for discussion would necessarily result in many additional equations having to be presented as background.

Issues

The issues on Appeal are as follows:

(1) Whether the subject matter of Claims 1 - 20 constitute statutory subject matter under the provisions of 35 U.S.C. § 101;

(2) Whether Claims 12 and 13 comply with the requirements of 35 U.S.C. § 112, second paragraph, by virtue of the use of the word "stability" in line 1 of Claim 12 and the use of "compatibility" in Claim 13;

(3) Whether the subject matter of Claims 1 -3, 14 and 15 is anticipated under 35 U.S.C. §102(a) by Stability of the Fast Multipole Method for the Helmholtz Equation, Rokhlin et al.;

(4) Whether the subject matter of Claims 1 - 3, 14 and 15 is anticipated under 35 U.S.C. § 102(b) by "A Parallel Fast Multipole Method for the Helmholtz Equation," Stalzer, Parallel Processing Letters, Vol. 5, No. 2 (1995), p. 263 -274, or "Parallelizing the Fast Multipole Method for the Helmholtz Equation," Stalzer, Optical Physics Laboratory, or "The Fast Multipole Method for the Wave Equation, A Pedestrian Proscription," Coifman et al, IEE Antenna and Propigation Magazine, Vol. 35, No. 3, June 1993, p. 7 - 12;

(5) Whether the subject matter of Claims 4 - 13 and 16 - 20 would have been obvious to a person of ordinary skill in the art at the time the subject matter of those Claims was made under the provisions of U.S.C. §103(a) as being unpatentable over the aforementioned Stalzer (Parallel Processing Letters) or Stalzer (Optical Physics Laboratory) or Coifman et al references, in view of "official notice ^ that these details

would have been obvious to one of ordinary skill in the art at the time of the invention."; and

(6) Whether the subject matter of Claims 1 - 20 would have been obvious to a person of ordinary skill in the art under the provisions of 35 U.S.C. §103(a) as being unpatentable over U.S. Patent No. 5,424,963 (Turner et al) or U.S. Patent No. 5,915,2039 (Berne et al) in view of "official notice ^ that these details would have been obvious to one of ordinary skill the art at the time of the invention."

Grouping of the Claims

The patentability of Claims 1 - 20 stands or falls together as a group.

Argument

In the Final Rejection dated February 28, 2000, claims 1-20 were rejected under 35 U.S.C. §101 because the Examiner stated the claimed invention is directed to non-statutory subject matter, the Examiner contending that Appellant is attempting to claim an algorithm because there is no pre-processing or post-processing of real data.

Appellant submits that the Examiner is using an outmoded definition of, or criterion for, statutory subject matter. To the extent that the Examiner has adopted the criterion of whether pre-processing and/or post-processing of real data exists on the basis of the guidelines set forth in MPEP 2106, Appellant respectfully submits that those guidelines have at least been modified, if not superceded, by recent decisions of the United States Court of Appeals for the Federal Circuit. The guidelines are more restrictive than the decisions from the Court of Appeals for the Federal Circuit. Those guidelines were promulgated before the most important decision rendered to date by the Federal Circuit on this subject matter, namely *State Street Bank & Trust Co. v.*

Signature Financial Group, Inc., 47 U.S.P.Q.2d 1596 (Fed. Cir. 1998), cert. den. (1999). Another extremely important decision from the United States Court of Appeals for the Federal Circuit which occurred after the aforementioned guidelines were promulgated is *AT&T Corp. v. Excel Communications, Inc.*, 50 U.S.P.Q.2d 1447 (Fed. Cir. 1999).

In the *State Street Bank* decision, the Court of Appeals for the Federal Circuit stated (47 U.S.P.Q.2d 1602) that the question of whether a claim encompasses statutory subject matter should focus on "the essential characteristics of the subject matter, in particular, its practical utility." The Federal Circuit also provided a test for identifying "unpatentable mathematical algorithms" by stating (47 U.S.P.Q.2d 1601) that "unpatentable mathematical algorithms are identifiable by showing that they are merely abstract ideas constituting disembodied concepts or truths that are not 'useful.'" The Federal Circuit further stated that "from a practical standpoint, this means that to be patentable an algorithm must be applied in a 'useful' way."

In the *AT& T Corp.* case, citing extensively from *State Street Bank*, the Federal Circuit stated (50 U.S.P.Q.2d 1453) that "the mere fact that a claimed invention involves inputting numbers, calculating numbers, outputting numbers, and storing numbers, in and of itself, would not render it non-statutory subject matter, unless, of course, its operation does not produce a 'useful concrete and tangible.'" At the same page, the Federal Circuit stated "Our inquiry here focuses on whether the mathematical algorithm is applied in a practical manner to produce a useful result."

The subject matter of claims 1-20 of the present application is a method for producing a computer simulation to identify an electromagnetic field of a body which has a number of sub-regions containing a number of charges and currents. The end

result of the method is an identification of the electromagnetic field of the body. This is the type of "tangible" thing which the Court of Appeals for the Federal Circuit has held to constitute statutory subject matter, and identifying the electromagnetic field associated with a body must unquestionably be considered a "useful" result in the context of these decisions.

Moreover, even if the Examiner's requirement of demonstrating "post-processing" of real data is adopted, Appellant respectfully submits claims 1-20 satisfy this standard. In each of the independent claims, the first step is to undertake a global multipole expansion and a local multipole expansion. These expansions result in a set of numerical values which represent real data, namely the effect of charges and currents at points in each of the sub-regions, as well as within a given sub-region. These numerical values are then used to determine the electromagnetic field of the body, in the second step of each of the independent claims. Thus, in the second step the real data obtained in the first step are "post-processed" to identify the electromagnetic field.

Appellant therefore respectfully submits that all claims of the application qualify as statutory subject matter under 35 U.S.C. §101.

By Amendment B filed simultaneously herewith, Appellant is proposing to amend Claim 12 to address the rejection thereof under 35 U.S.C. § 112, second paragraph. Claim 12 as amended in Amendment B refers to stability of the method. Claim 12 specifically refers to ensuring that stability of the method is maintained at low frequencies, which is described in the section beginning at page 50 of the present Specification. The Examiner's comment that Claim 12 does not define stability "of what"

seems to suggest that the Examiner believes there must always be some point of reference in order to identify stability. Mathematical stability, however, is a well known "stand alone" term and merely refers to whether a system represented by mathematical equations will converge at poles or not. Appellant therefore respectfully submits that, if the amendment to Claim 12 is entered, Claim 12 is in full compliance with all provisions of Section 112.

The term "compatibility" in claim 13, as set forth in the claim, refers to electromagnetic compatibility, and is intended to encompass the meaning of DIN standard VDE 0870, cited at page 1 of the present specification. Since this is an industry standard, Appellant respectfully submits the term "electromagnetic compatibility" is unusually specifically known and understood by those of ordinary skill in the art. The Examiner's question relating to "victim and aggressor nets" is therefore not understood and is not seen to have any relationship to the aforementioned DIN standard.

Claim 13 is therefore respectfully submitted to be in full compliance with all provisions of 35 U.S.C. §112.

In several locations in the Final Rejection, the Examiner stated that the claimed subject matter is taught in undergraduate college electromagnetic courses, and the subject matter of claim 2 is taught in graduate electromagnetic courses. The Examiner referred to a text book by Jackson entitled "Classical Dynamics." It is not clear whether this was intended to be a rejection based on this text, or based on common knowledge in the art, but if so the Examiner did not provide a copy of the text and Appellant respectfully submits that the manner by which paragraph 6 is written is a gross over-

simplification of the claimed subject matter. Of course, Appellant does not deny that it is unavoidable, when determining the magnetic field of a given region, to use the superposition principle, but all claims of the application are more detailed that general principle. The Examiner has not identified any prior art source in claim 6 which teaches or suggests the use of a global multipole expansion or a local multipole expansion in the context of identifying electromagnetic fields.

Claims 1-3, 14 and 15 were rejected under 35 U.S.C. §102(a) as being anticipated by Rokhlin et al. The Rokhlin et al. reference discloses a fast multipole method for electromagnetic simulations, but again there is no mention or suggestion in this article of undertaking a global multipole expansion and/or a local multipole expansion, and then superimposing the results of those expansions to simulate an electromagnetic field of a body, as set forth in each of the independent claims of the application. It should be noted that Appellant cited another article by Rokhlin at page 1 of the present specification, and identified a basic disadvantage with this conventional technique, namely the fact that the multipole coefficients are not explicitly calculated, and this, in turn, can result in spurious distortions which cause errors in the multipole expansions. Certainly as to independent claim 15 there is nothing even remotely as explicit as the method steps set forth in claim 15 in the Rokhlin et al. article relied upon by the Examiner. The Examiner has not even made an effort to show where those very explicit calculating steps of claim 15 are allegedly taught by Rokhlin et al.

Claims 1-3, 14 and 15 were also rejected under 35 U.S.C. §102(b) as being anticipated by Stalzer (Parallel Processing Letters) or Stalzer (Optical Physic Laboratory) or Coifman et al. Again, Appellant does not find any suggestion or explicit

teaching in any of those references to use a global multipole expansion and a local multipole expansion, and then to superimpose the results to identify the electromagnetic field of a body. The Examiner has merely stated that each of those references discloses "details of multipole expansions, matrix methods and regions," but has not identified even the basic steps of the independent claims of the present application of conducting a global multipole expansion, conducting a local multipole expansion, and superimposing the results from various regions of a body in order to identify the electromagnetic field.

Dependent claims 4-13 and 16-20 were rejected under 35 U.S.C. §103(a) as being unpatentable over the same references discussed above in view of "official notice." Since each of those dependent claims adds further method steps to the novel methods of the respective independent claims, Appellant respectfully submits the Examiner has failed to present a *prima facie* case of obviousness based on these references themselves. Again, the Examiner has merely stated that the references respectively "disclose details of multipole expansions, matrix methods and regions," but has not suggested or provided a reasoning why a person of ordinary skill in the art would be motivated to modify any of those references to arrive at the subject matter of claims 4-13 and 16-20. Since those dependent claims were rejected under 35 U.S.C. §103 (as opposed to 35 U.S.C. §102), presumably the Examiner acknowledged that some modification must be necessary. Given this premise, it is also necessary for the Examiner to demonstrate some motivation or inducement found in the references to undertake such a modification. The Examiner's very general statements regarding these references provide no such information, and it is for this reason that Appellant

respectfully submits a *prima facie* case of obviousness has not been presented by the Examiner.

Moreover, Appellant respectfully submits the Examiner has improperly used the concept of "official notice," by reciting so called "minor details" which the Examiner acknowledges are not disclosed in the references, and the stating "official notice is taken that these details would have been obvious to one of ordinary skill in the art at the time of the invention." According to MPEP 2144.03, the concept of "official notice" is used to avoid the Examiner having to cite evidence or proof of "facts outside of the record which are capable of instant and unquestionable demonstration as being 'well known' in the art." The concept of "official notice" is therefore intended to relieve the Examiner of the responsibility of the Examiner having to document fundamental *facts*. The concept of "official notice" is not intended to relieve the Examiner of the duty to present a *prima facie* case of obviousness, and cannot be substituted for an obviousness analysis. If the Examiner were permitted to take "official notice" that certain details "would have been obvious to a person of ordinary skill in the art at the time of the invention," as the examiner has done in the final rejection, the Examiner could substitute "official notice" for any purported obviousness conclusion. The Examiner may possibly be justified in taking "official notice" that the items which the Examiner has characterized as "minor details" are well known to those of ordinary skill in the art. Having taken "official notice" of this fact, however, it is still incumbent on the Examiner to present a *prima facie* case of obviousness based on those facts, rather than subsuming such an obviousness analysis within the overall "official notice" concept.

Lastly, claims 1-20 were rejected under 35 U.S.C. §103(a) as being unpatentable over Turner et al. or Berne et al., in view of "official notice" as discussed above.

The Turner et al. reference discloses a method for molecular dynamics simulation, and an apparatus for executing the method. The model which is to be produced is based on information regarding atomic structure. Even though such modeling may represent a highly complex undertaking, this does not constitute a teaching or suggestion or inducement to those of ordinary skill in the art to employ multipole expansion for the purpose of simulating an electromagnetic field of a body. The Examiner cited language at column 17, line 36 in the Turner et al. reference, however, this reference does not make any statement regarding the determination of an electromagnetic field of a body, but instead refers to electrostatic reactions, or interactions.

The Berne et al. reference is a method for simulating biomolecular systems with remote electrostatic reactions. Again, there is no suggestion in this reference to undertake either a global or a local multipole expansion of regions of a body, and to superimpose the results of those expansions, in order to determine the electromagnetic field of the body.

In general, Appellant respectfully submits the Examiner has assumed that since the superposition principle is known, and since mathematical techniques for multipole expansion are known, it would somehow be obvious to employ multipole expansions in the context of electromagnetic field simulation. The references of record are the best evidence against this conclusion, because despite extensive literature on the subject of multipole expansions, there is no statement in any of the references describing how

a global multipole expansion and a local multipole expansion can be employed to simulate an electromagnetic field, as set forth in the claims of the present application.

The same comments regarding "official notice" as discussed above in connection with the rejection of Claims 4 - 13 and 16 - 20 apply to the rejection of 1 - 20. All claims of the application are therefore submitted to be in condition for allowance, and early reconsideration of the application is respectfully requested.

Conclusion

For the foregoing reasons, Appellant respectfully submits the Examiner is in error in rejecting Claims 1 - 20 of the present application. Reversal of the rejection of Claims 1 -20 is justified and the same is respectfully requested.

This Appeal Brief is accompanied by a check in the amount of $300, as required by 37 C.F. R.§ 1.17(c).

Respectfully submitted,

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CERTIFICATE OF MAILING

I hereby certify that this correspondence is being deposited in triplicate with the United States Postal Service as First Class Mail in an envelope addressed to:

Assistant Commissioner of Patents
Washington, D.C. 20231

on July 20, 2000

Steven H. Noll

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APPENDIX A

1. A computer-aided simulation method for determining an electromagnetic field of a body which has a plurality of subregions and contains a plurality of charges and currents, comprising the steps of:

performing, in each case of the plurality of subregions, a global expansion, which represents an effect of charges and currents for distant points in a respective subregion of the plurality of subregions in the multipole expansion, and a local multipole expansion, which represents an effect of charges and currents at points inside the respective subregions of the plurality of subregions in a multipole expansion; and

determining the electromagnetic field of the body by superposition using the global multipole expansion and the local multipole expansion of the plurality of subregions.

2. The method according to Claim 1, wherein the following steps for determining the electromagnetic field of the body are carried out iteratively until an error measure is of a predetermined small size, $I = 0$ being taken as an initial condition:

a) calculating the global multipole expansions with global multipole coefficients according to

$c^g \quad = GI,$

c^g being a vector made up of the global multipole coefficients of the plurality of subregions,

I being a vector which specifies a given current distribution,

G being a matrix determining the global multipole coefficients in a respective subregion of the plurality of subregions for the given current distribution I;

b) calculating the local multipole expansion with local multipole coefficients according to

c^g $= Tc^g$,

c^g being a vector made up of the local multipole coefficients of the plurality of subregions,

T being a translation matrix through which the global multipoles are combined into local multipoles;

c) determining the electromagnetic field from

ZI $= Z' I + Lc^1$,

Z denoting an impedance matrix,

Z′ denoting a part of the impedance matrix Z, representing coupling between the subregions,

L denoting a matrix for evaluating the local multipole coefficients.

3. The method according to Claim 2, wherein an element which has an impedance and which is a component of the subregion of the body is taken into account directly in the matrix Z′ as an impedance.

4. The method according to Claim 1, wherein the subregions are of equal size.

5. The method according to Claim 1, wherein a size of the subregions is proportional to a distance from an observer region.

6. The method of Claim 1, wherein each subregion of the plurality of subregions is respectively assigned to a zone with uniform physical attribute.

7. The method according to Claim 1, wherein a respective subregions of the plurality of subregions is split into up to eight zones.

8. The method according to Claim 1, wherein the electromagnetic field is determined for predetermined frequencies.

9. The method according to Claim 8, wherein the predetermined frequencies are determined by a minimum frequency and by a maximum frequency, the method being started at the minimum frequency and the electromagnetic field being determined for each frequency, continuing as far as the maximum frequency, with a predetermined step size.

10. The method according to Claim 8, wherein the predetermined frequencies are determined by a minimum frequency and by a maximum frequency, the method of being started at the maximum frequency and the electromagnetic field being determined for each frequency, continuing as far as the minimum frequency, with a predeterminable step size.

11. The method according to Claim 8, in which the predetermined frequencies are determined by a minimum frequency and by a maximum frequency, the method being started at a frequency between the minimum frequency and the maximum frequency, and the electromagnetic field being determined for each frequency, continuing as far as one of the maximum frequency or the minimum frequency, with a predetermined step size.

12. The method according to Claim 1, wherein a stability of said method at low frequencies is ensured by carrying the global multipole expansions using elements[1].

13. The method according to Claim 1, wherein the electromagnetic compatibility of the body is determined.

14. A computer-aided simulation method for determining an electromagnetic field of a body which has a plurality of subregions and contains a plurality of charges and currents, comprising the steps of:

performing for predetermined frequencies, in each of the plurality of subregions, a global multipole expansion, which represents an effect of charges and currents for distance points in a respective subregion of the plurality of subregions in a multipole expansion, and a local multipole expansion, which represents an effects

[1] Claim 12 above is in the form as set forth in Amendment B accompanying filing the Appeal Brief.

of charges and currents at points inside the respective subregions of the plurality of subregions in a multipole expansion; and

determining the electromagnetic field of the body for the predetermined frequencies by superposition using the global multipole expansion and the local multipole expansion for the plurality of subregions.

15. The method according to Claim 14, wherein the following steps for determining the electromagnetic field of the body are carried out iteratively until an error measure is of a predetermined small size, I = 0 being taken as an initial condition:

a) calculating the global multipole expansions with global multipole expansions with global multipole coefficients according to

$c^g = GI$,

c^g being a vector made up of the global multipole coefficients of the plurality of subregions,

I being a vector which specifies a given current distribution,

G being a matrix determining the global multipole coefficients in a respective subregion for the given current distribution I;

b) calculating the local multipole expansion with local multipole coefficients according to

$c^1 = Tc^g$,

c^1 being a vector made up of the local multipole coefficients of the plurality of subregions,

T being a translation matrix through which the global multipoles are combined into local multipoles;

c) determining the electromagnetic field from

$ZI = Z' I + Lc^1$,

Z denoting an impedance matrix,

Z′ denoting a part of the impedance matrix Z, representing coupling between the subregions,

L denoting a matrix for evaluating the local multipole coefficients.

16. The method according to Claim 14, wherein the predetermined frequencies are determined by a minimum frequency and by a maximum frequency, the method being started at the minimum frequency and the electromagnetic field being determined for each frequency, continuing as far as the maximum frequency, with a predetermined step size.

17. The method according to Claim 14, wherein the predetermined frequencies are determined by a minimum frequency and by a maximum frequency, the method being started at the maximum frequency and the electromagnetic field being determined for each frequency, continuing as far as the minimum frequency, with a predeterminable step size.

18. The method according to Claim 14, in which the predetermined frequencies are determined by a minimum frequency and a maximum frequency, the method being started at a frequency between the minimum frequency and the maximum frequency, and the electromagnetic field being determined for each

frequency, continuing as far as one of the maximum frequency or the minimum frequency, with a predetermined step size.

19. A computer-aided simulation method for determining an electromagnetic field of a body which has a plurality f subregions and contains a plurality of charges and currents, comprising the steps of:

splitting each subregion of the plurality of subregions into a predetermined number of zones in the range of 2 to 8 zones;

performing, in each of the plurality of subregions, a global multipole expansion using elements for low-f[illegible]uency stability, the expansion representing, an effect of charges and currents lo[illegible]its in a respective subregion of the plurality of subregions in a multipole expansion, and a local multiple expansion, which represents an effect of charges and currents at points inside the respective subregions of the plurality of subregions in a multipole expansion; and

determining the electromagnetic field of the body by superposition using the global multipole expansion and the local multipole expansion for the plurality of subregions.

20. The method according to Claim 19, wherein the following steps for determining the electromagnetic field of the body are carried out iteratively until an error measure is of a predetermined small size, l = 0 being taken as an initial condition:

a) calculating the global multipole expansions with global multipole coefficients according to

$c^g \quad = GI,$

c^g being a vector made up of the global multipole coefficients of the plurality of subregions,

I being a vector which specifies a given current distribution,

G being a matrix determining the global multipole coefficients in a respective subregion of the plurality of subregions for the given current distribution I;

b) calculating the local multipole expansion with local multipole coefficients according to

$c^1 \quad = Tc^g,$

c^1 being a vector made up of the local multipole coefficients of the plurality of subregions,

T being a translation matrix through which the global multipoles are combined into local multipoles;

c) determining the electromagnetic field from

$ZI \quad = Z' I + Lc^1,$

Z denoting an impedance matrix,

Z' denoting a part of the impedance matrix Z, representing coupling between the subregions,

L denoting a matrix for evaluating the local multipole coefficients.